再生可能エネルギーを大規模導入した電力系統におけるグリッドセキュリティ制約を考慮した技術・経済的系統拡張計画

Form 3

Abstract

Title: **Grid Security-Constrained Techno-Economic Planning of Utility-Scale Renewable Energy Integration into Power Systems**

題目：再生可能エネルギーを大規模導入した電力系統におけるグリッドセキュリティ制約を考慮した技術・経済的系統拡張計画

The world energy demand is increasing rapidly due to the quest for modernization and industrialization while the fossil fuel reserves, which is the main source of energy supply, is depleting at almost the same rate or more. The environmental impacts of continuous burning of fossil fuels for electricity generation can be seen in the amount of harmful greenhouse gases that is being released into the atmosphere which has led to critical concern on climate change and environmental degradation issues. Hence, there is an increase quest for sustainable energy transition all over the world through active de-carbonization of the energy supply mix as addressed by the United Nations sustainable development goal 7. In view of the techno-economic and environmental requirements of modern energy infrastructure, electric utilities all over the world have paid more attention to the issues of power system security in the past few years. One of the important yardsticks for evaluating the operational security of any power system is the voltage stability assessment.

Voltage stability is essentially described as the ability of power systems to remain within a satisfactory voltage range at all buses under no-fault, fault and fault-cleared conditions. Heavily loaded (stressed) power systems are at the risk of voltage instability due to insufficient capacity to provide reactive power support at the local load points. However, increasing the share of renewable energy in power systems can help to improve the voltage stability condition and the overall power system security, if effectively planned. In this doctoral dissertation, grid voltage stability limit and the concept of economic load dispatch/optimal power flow, were deployed extensively to investigate the optimal penetration level of identified credible alternative energy resources (mainly utility-scale solar PV) into selected power systems without compromising the requirements for safe and secure technical and economic operation. Alongside the Nigerian 28 bus system, several IEEE standard systems are deployed as test cases at various aspect of this research work using MATLAB. Inferential techno-economic analysis were made from appropriately selected solution points for each planning problem reported in each chapter of the thesis and adequate recommendations were made for immediate implementations or/and future references.

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